



Successful Government Use of High Performance Computing

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Examples of High Performance Computing in the Federal Government (1)

- **DOE National Nuclear Security Agency: Advanced Scientific Computing Initiative (ASCI); comprehensive 3D+T physics models of nuclear weapons; supercomputers rank 2, 3, 4, 5, 15, 19, 28, 32 on Top500 list***
- **DOE Office of Science: Scientific Discovery through Advanced Computing; 51 projects totaling \$57M in climate, chemistry, fluid dynamics, fusion, high energy physics, software infrastructure, numerical libraries, software technology, collaborative tools; supercomputers rank 12, 16, 46, 61 on Top 500**

***www.top500.org**



Examples of High Performance Computing in the Federal Government (2)

- **NSF: Distributed Terascale Facility; HPC facilities for academic computing in physical sciences, biological sciences, engineering at UCSD, UIUC, Pittsburgh, ANL, Caltech; soon to be linked by 40 Gb/s network; 11.6 Tflops total peak; supercomputers rank 6, 82 on Top500**
- **NSF: NCAR climate/weather program; supercomputers rank 10, 33 on Top500**



Examples of High Performance Computing in the Federal Government (3)

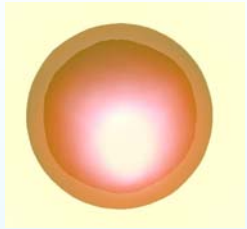
- **DoD: HPC Modernization Program; distributed supercomputers supporting Services and academic researchers; Supercomputers rank 11, 20, 29, 40, 54, 57, 59, 62 on Top500**
- **NOAA: Weather prediction, severe storms, climate modeling; supercomputers rank 8, 24, 25, 35, 36 on Top500**



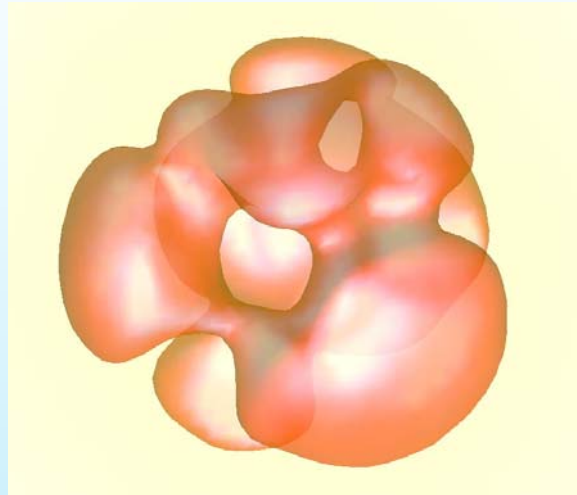
Examples of High Performance Computing in the Federal Government (4)

- **NASA: Climate and space simulations; GSFC supercomputer ranks 18 on Top500**
- **NASA: Aerospace technology, climate simulations; ARC supercomputer ranks 60 on Top500**

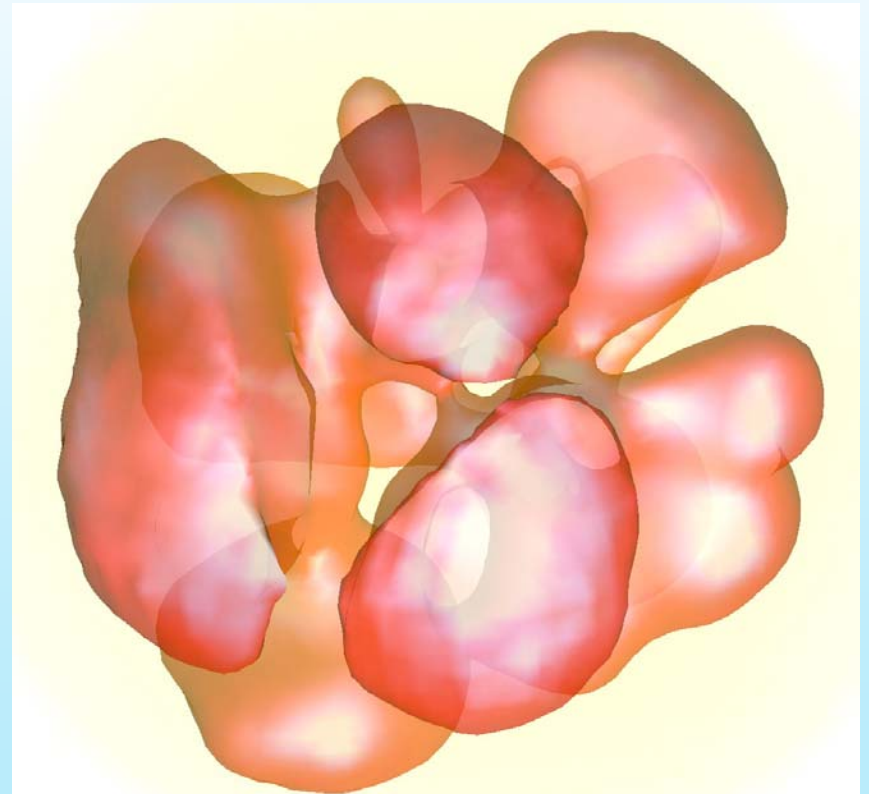
Explosion of a Super-Nova (not to scale) (DOE)



Start

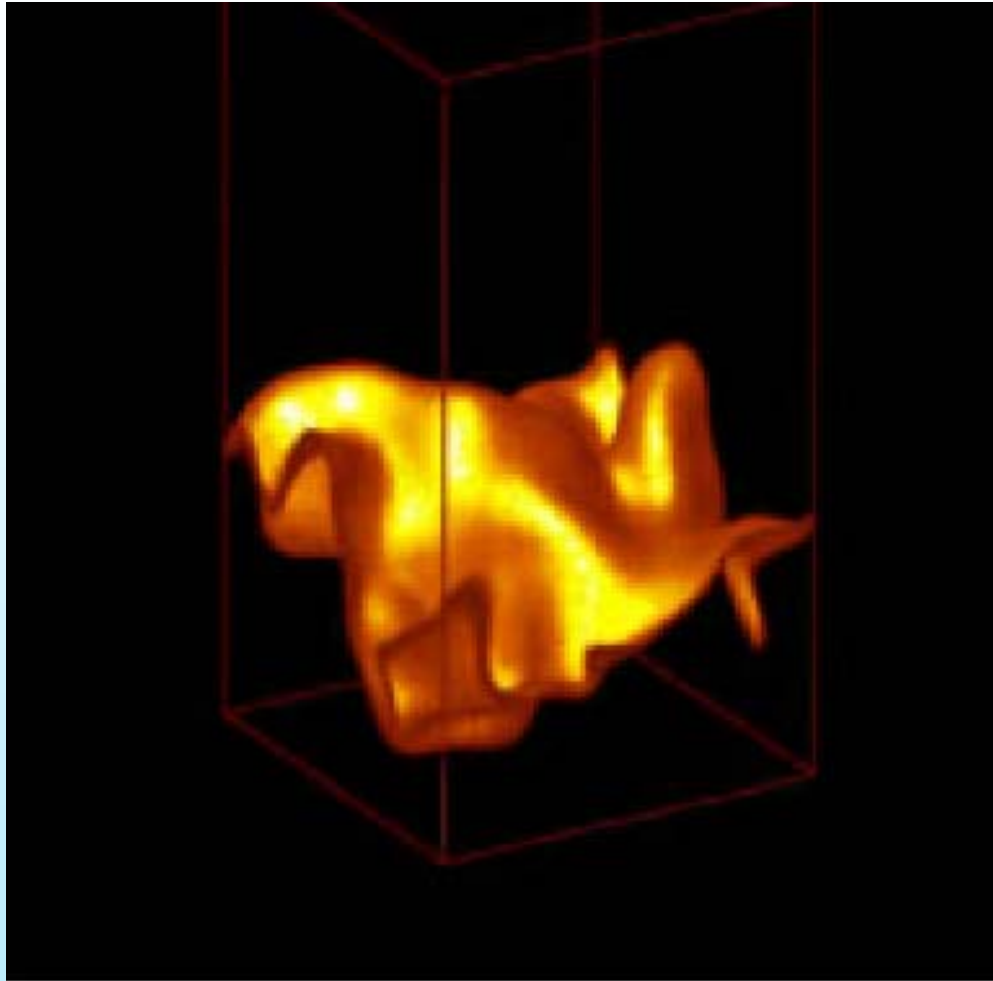


Middle



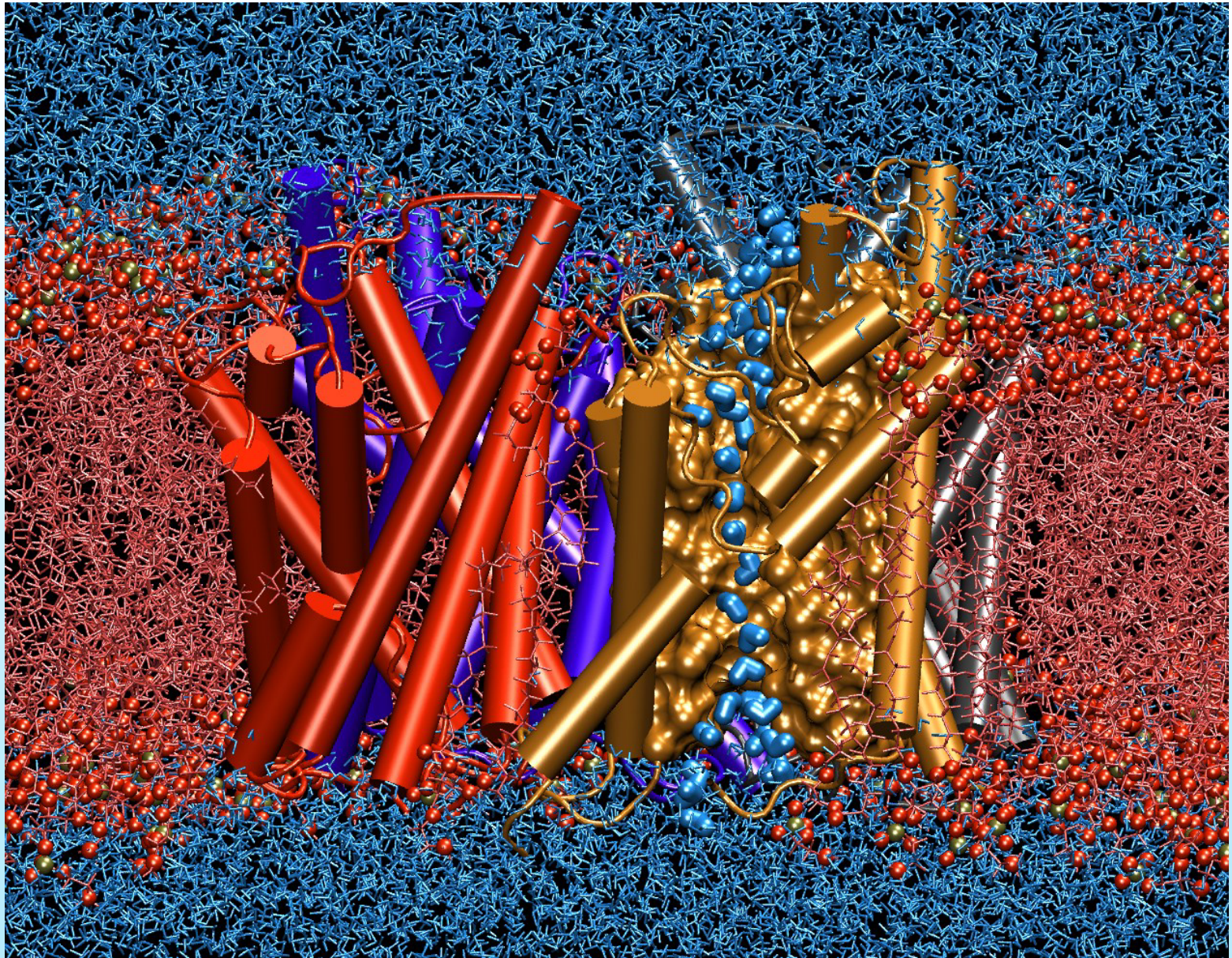
End

Simulation of Turbulent Flame with Comprehensive Chemistry (DOE)

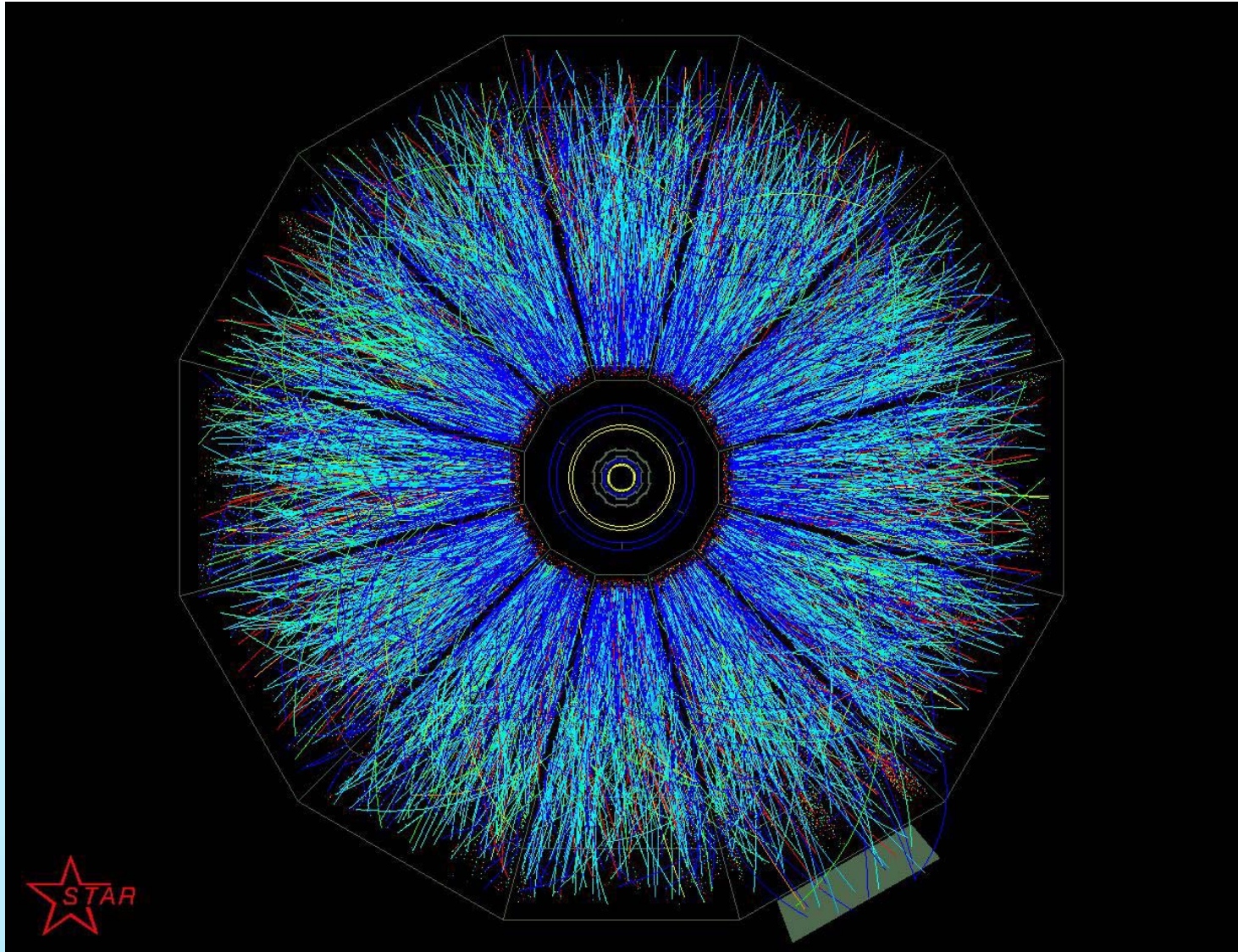


**Flame surface from simulation of a
turbulent premixed methane flame**

Simulation of Aquaporin Protein Inside a Cell (NSF & NIH)



Collision of Deuterium Ion with Gold in Relativistic Heavy Ion Collider (DOE)



Grid Communications & Applications: High End Physics Problem



Compact Muon Solenoid at CERN

~PBytes/sec

Online System

~100 MBytes/sec

1 TIPS is approximately 25,000
SpecInt95 equivalents

Offline Processor Farm

~20 TIPS

~100 MBytes/sec

There is a "bunch crossing" every 25 nsecs.

There are 100 "triggers" per second

Each triggered event is ~1 MByte in size

Tier 0

CERN Computer Centre

Tier 1

France Regional
Centre

Germany Regional
Centre

Italy Regional Centre

FermiLab ~4 TIPS

~622 Mbits/sec
or Air Freight (deprecated)

Tier 2

Caltech
~1 TIPS

Tier2 Centre ~1
TIPS

Centre ~1
TIPS

Centre ~1
TIPS

Centre ~1
TIPS

~622 Mbits/sec

~622 Mbits/sec

Institute
~0.25TIPS

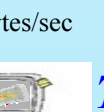
Institute

Institute

Institute

Physics data cache

~1 MBytes/sec



Tier 4

Physicist workstations

Physicists work on analysis "channels".

Each institute will have ~10 physicists working on one or more
channels; data for these channels should be cached by the institute
server



Characteristics of Successful Modern High Performance Computing Programs

- **Closely coupled to Agency Missions**
- **Managed as a strategic priority, with stable funding and support – typically not based on “pay by the pound”**
- **Strong leadership from above; strong science/engineering from below**
- **Projects involve experts in discipline science, computer science, mathematics**
- **Projects and programs are periodically peer reviewed for quality**
- **Successes are publicized to justify Agency and program funding**



High End Computing Revitalization Task Force (HECRTF)

- **Charge: develop a 5-year plan to guide federal investments in HEC, based on the needs of important federal applications of HEC**
- **Tasks:**
 - Roadmap for core technology development
 - Road map for meeting resource needs of applications
 - Recommendations for improvements to the procurement process for HEC systems
- **Schedule**
 - May: rough draft
 - June: good draft
 - August: final report



For Further Information

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